PREFACE

Within the jurisdiction of the Kingdom Fungi, a number of extraordinary conditions have been enforced upon scientists – things that are well known to make scientists from other disciplines shake their heads in disbelief. The need to make two or more valid, parallel species names for just one genetic species has been of these weird but necessary scientific adaptations. Similarly, the complete confounding of the idea of an individual, with one single "self" or genet potentially having a worldwide distribution based on millions of colonies, is another strange fungal situation. The present volume deals with yet another uniquely fungal problem, which is the abundant existence of easily grown and ecologically important species that have been, in effect, impossible to handle scientifically. These are filamentous fungi producing morphology that has no truly distinctive features, nothing that would allow reliable classical species description. Moreover, these species share with other hyphal fungi the problem that since the filamentous growth form forces organisms to deal with a succession of changing conditions in the materials they progress through, they are obliged to be physiologically adaptable. They have not had the luxury of developing the extended series of simple, static metabolic regularities that have allowed most yeasts and bacteria to be phenotypically classified. These fungi, as far as we know, simply can't be phenotypically dealt with in any normal, reliable way.

It may seem incredible that for over 80 years, people working with fungi have been isolating and, in most cases, simply throwing away unstudied, large numbers of species that cannot be integrated into science because they cannot be named. Yet this has been one of the ordinary features of our scientific lives; in fungal ecology in particular, we have all done it. Or, if we have been so bold as to designate a common isolate type "dark mycelium type 1" or something along those lines, we have been well aware that this was scientifically ineffectual. To the great relief and excitement of everyone involved in fungal ecology, molecular biology has at last allowed us to get a grip on such enigmatic organisms. Meanwhile, molecular soil ecologists, getting a little ahead of phylogenetic systematists in coming into contact with some of these fungi, have been amazed to see that large numbers of the fungal sequences arising from direct substrate DNA studies, especially soil or root studies, can't be rationalized with any described taxa. Almost any BLAST search done these days with an ascomycetous fungus shows that GenBank is stuffed with unidentified sequences labelled "uncultured root fungus" or something similarly nonspecific. In a few cases, the abundance of these sequences has given rise to a myth that there must be large numbers of unculturable ascomycetous fungi in soils. How to explain to people that mycologists have been seeing these mystery fungi all along, but have had no pre-molecular methods that could bring them definitively into the scientific fold? These organisms mostly grew very happily in culture but nonetheless succeeded in thumbing their hyphal noses at science for almost a century.

The present volume helps to bring the molecular biological revolution to some of these "missing lineages." Included are some fungi fitting the classic ecological category of 'sterile root fungus,' as well as others that do sporulate, but only after very long incubation. Also, the conidial soil- and root-associated fungal genus *Oidiodendron*, which shares with 'sterile root fungi' the problem of having morphology so reduced that reliable species distinction has been next to impossible, is reexamined with advanced phenotypic methodologies to find distinctions reflecting the molecular genetic distinctions that are now known within the group. The first part of the present volume, then, consists of biosystematic studies elucidating either the primary phylogenetic systematics, or the post-molecular phenotypic reinterpretation, of previously intractable groups of root-associated fungi and their relatives.

Such biosystematic studies have the effect of bringing order to what would otherwise be chaotic ecological studies – since there is nothing so dizzying as an ecological study where all the organism names used are unreliable or, as may happen after a few years, completely uninterpretable. To stress the point that biosystematic advances immediately and automatically facilitate ecological advances, the second part of this volume consists of ecological studies and reviews in which both new and historical data about root-associated fungi are evaluated in the light of our nascent biosystematic knowledge of "the missing lineages." The fact that reproducible scientific progress can finally be made with 'sterile root fungi' has led to an explosion of interest in this area, and this volume celebrates and participates in this long-delayed outburst of scientific enthusiasm.

Richard C. Summerbell

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